
Space Weather Technical Forecast

Issued on Wednesday 16 October 2024 at 13:20 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Ongoing Chance of further M-flares. Increasing Chance of G1 Minor Geomagnetic Storm from day 3 (18 Oct) onwards.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with several M-flares observed through the period, with a peak flare of M3.7 at 16/0323 UTC from AR3852.

There are currently seven sunspot regions on the Earth facing disc, with the new region in the southeast recently numbered AR3859. AR3852 and AR3854 in the southwest quadrant are the most prominent spot groups on the disc, being responsible for the majority of flare activity. Both have shown small changes in evolution, however AR3854 has seen further small lead/intermediate spot emergence as well as some fragmentation of its leader spot. AR3856 has re-emerged in the north-centre disc after previously fading, showing some minor flare activity. Other numbered spot groups are currently small and magnetically simple.

A number of CMEs have been observed in available imagery, however these are all off the Earth-Sun line, and not thought Earth-directed.

Solar Wind / Geomagnetic Activity: Solar winds varied between background and slightly elevated levels, in the range 370-440km/s. Density was mainly at average to below average levels. The Interplanetary Magnetic Field (IMF), Bt, was predominantly moderate, varying between 6 and 10 nT. The Bz component varied in direction throughout, ranging between +/-8 nT. Phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp2-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate with peak 465 pfu at 15/1810 UTC. The associated 24-hour fluence was below the Active. The 16/0000 UTC observation was 7.79e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Further Moderate activity is expected with a slight chance of isolated X-class flares.

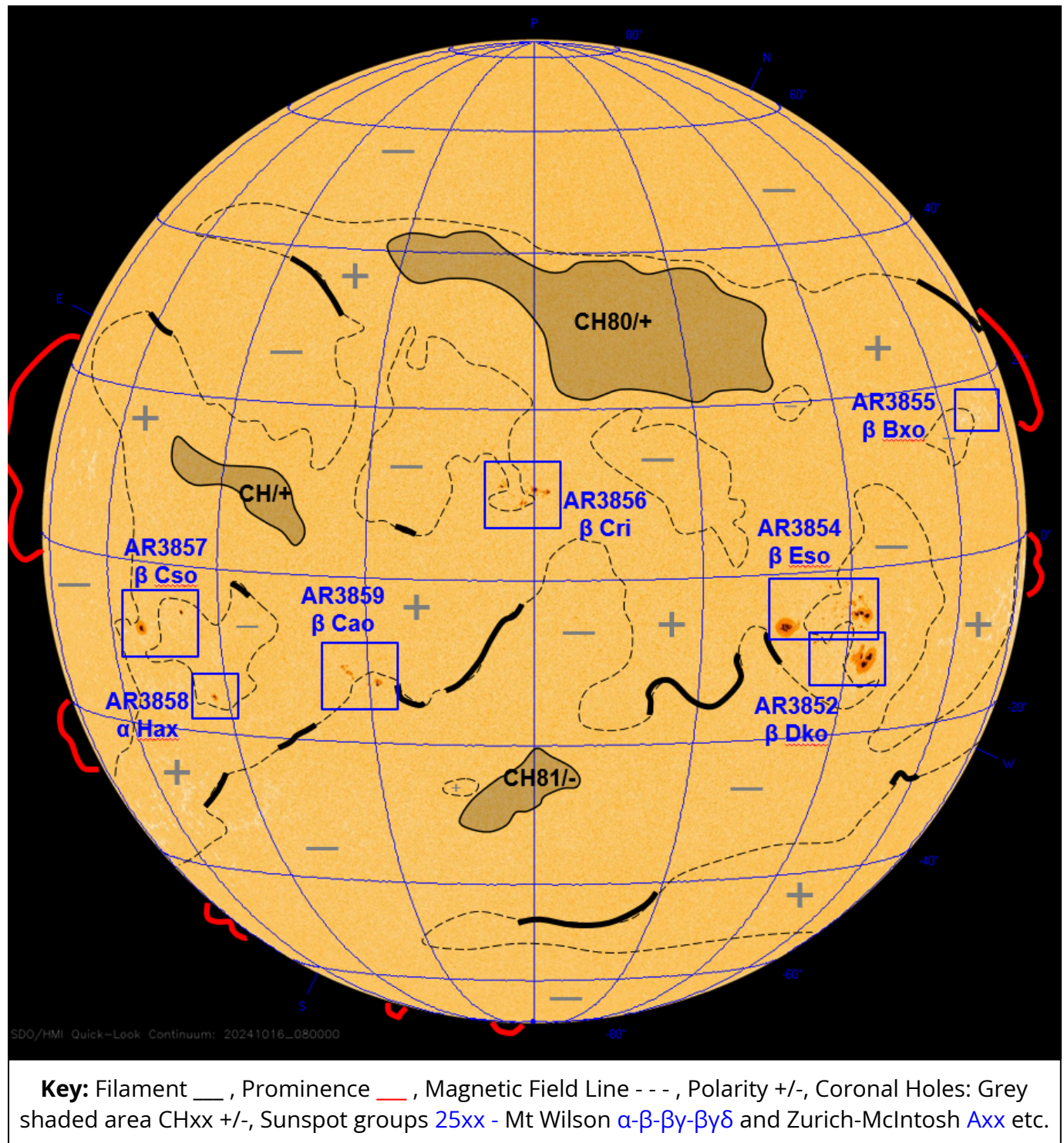
Solar Wind / Geomagnetic Activity: Ongoing slightly elevated solar winds and residual weak CME influence are expected to gradually ease through day 1 (16 Oct). There is then the potential

for elevated winds to develop from day 3 (18 Oct) onwards, due to a high speed stream in association with the large CH80/+.

Overall, geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with waning CME effects and then coronal hole influence later, and there is an increasing chance of isolated G1 Minor Storm intervals on days 3 and 4 (18 and 19 Oct).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES-18 is now largely at background, but there remains a slight chance of further enhancements given any significant flares. High energy electron flux may rise as solar winds ease and the Van Allen belts expand outward again. This brings a chance of High flux, although tempered by any waning CME effects and any fast wind onset. The associated 24 hour fluence is expected to rise, but thought most likely to remain below Active ($1e8$ total pfu).

Figure 1: Solar Synoptic Map valid 16/0800 UTC.



Geomagnetic Storms

The M2.1 flare from AR3854 at 15/1833 UTC had an associated Type II radio emission of 883 km/s, however no outgoing CME has been observed in available imagery in association with this.

Ongoing slightly elevated solar winds and residual weak CME influence are expected to gradually ease during day 1 (16 Oct). There is then the potential for elevated winds to develop from day 3 (18 Oct) onwards, due to a high speed stream from the large coronal hole currently straddling north-centre disc (CH80/+). This feature is significantly larger and more clearly defined than the previous rotation, and an increase in solar winds towards slightly elevated to elevated speeds looks likely by the end of the period.

MOSWOC ENLIL output is providing limited guidance. Currently over-estimating the extent of the fast wind from the southwestern disc, and has little signal for CH80/+ later in the period. This likely due to current limitations with GONG H-alpha imagery that is used for the initialisation of the model.

Overall, geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals, initially at first and then towards the end of the forecast period, associated with waning CME effects and then coronal hole influence later. There is an increasing chance of isolated G1 Minor Storm intervals days 3 and 4 (18 and 19 Oct) as CH80/+ becomes more geo-effective.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	5	20	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO/AIA 211 satellite image. The large dark area in the northern hemisphere is coronal hole CH80/+.

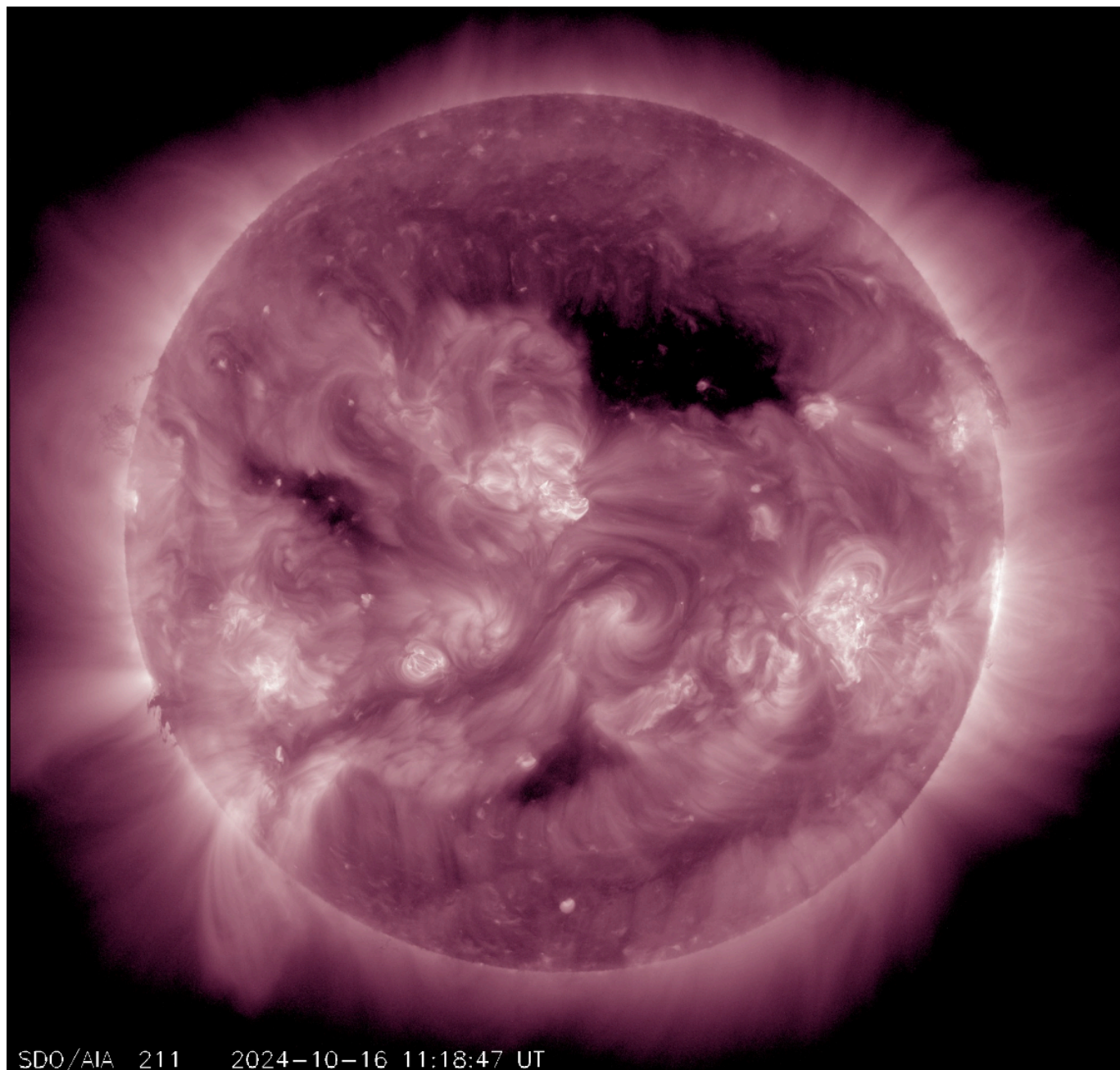
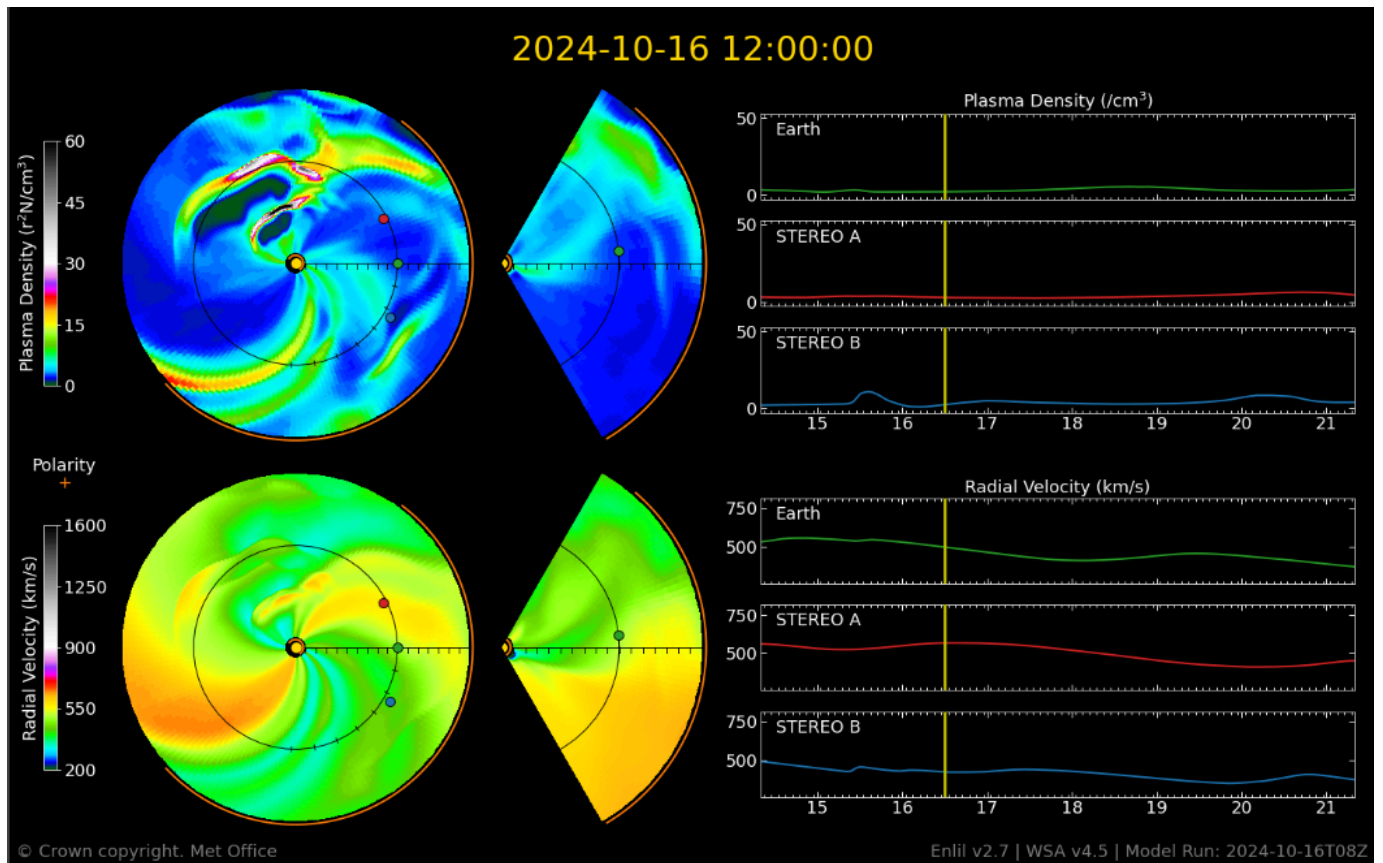


Figure 3: MOSWOC Enlil.



Radio Blackouts - X-Ray Flares

There are currently seven sunspot regions on the Earth facing disc, with the new region in the southeast recently numbered AR3859. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc, being responsible for the majority of flare activity. Both spot groups have shown small changes in evolution, however AR3854 has seen further small lead/intermediate spot emergence as well as some fragmentation of its leader spot. AR3856 has re-emerged in the north-centre disc after previously fading, showing some minor flare activity. In addition, ex-AR3848 beyond the west limb will continue to contribute to the flare risk in the short term. Other numbered spot groups are currently small and magnetically simple.

Solar activity has been Moderate with six M-flares observed through the period, with a peak flare of M3.7 at 16/0323 UTC from AR3852. Further occasional Moderate flares are expected, with an ongoing slight chance of an isolated X-class flare.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	40	40	40	40
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 4: GOES-16 & -18 X-ray flux.

Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but there remains a slight chance of enhancement given any notable flares, primarily from AR3848 in the near term from over the western limb, but also from AR3852/54 now located in the western portion of the disc.

Any significant enhancement will bring a slight chance of exceeding the S1 Minor Radiation Storm threshold.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux (greater than 2MeV) as observed by GOES-16 have been at background to moderate levels. As solar winds ease, flux may rise at GEO to become Moderate to High. However, this is low confidence, especially with waning CME effects at the start of the period and then a possible high speed stream onset from later day 3 (18 Oct). Any such enhancement is likely to suppress flux at GEO to background levels again.

The associated electron fluence is therefore expected to be below the Active level ($1\text{e}8$ total pfu), but with a possible rising trend into days 2 and 3 (17 and 18 Oct). MOSWOC REFM model output is viewed as reasonable guidance at present.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^8$	No	10	20	30	20
Very Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: GOES-16 Electron flux.

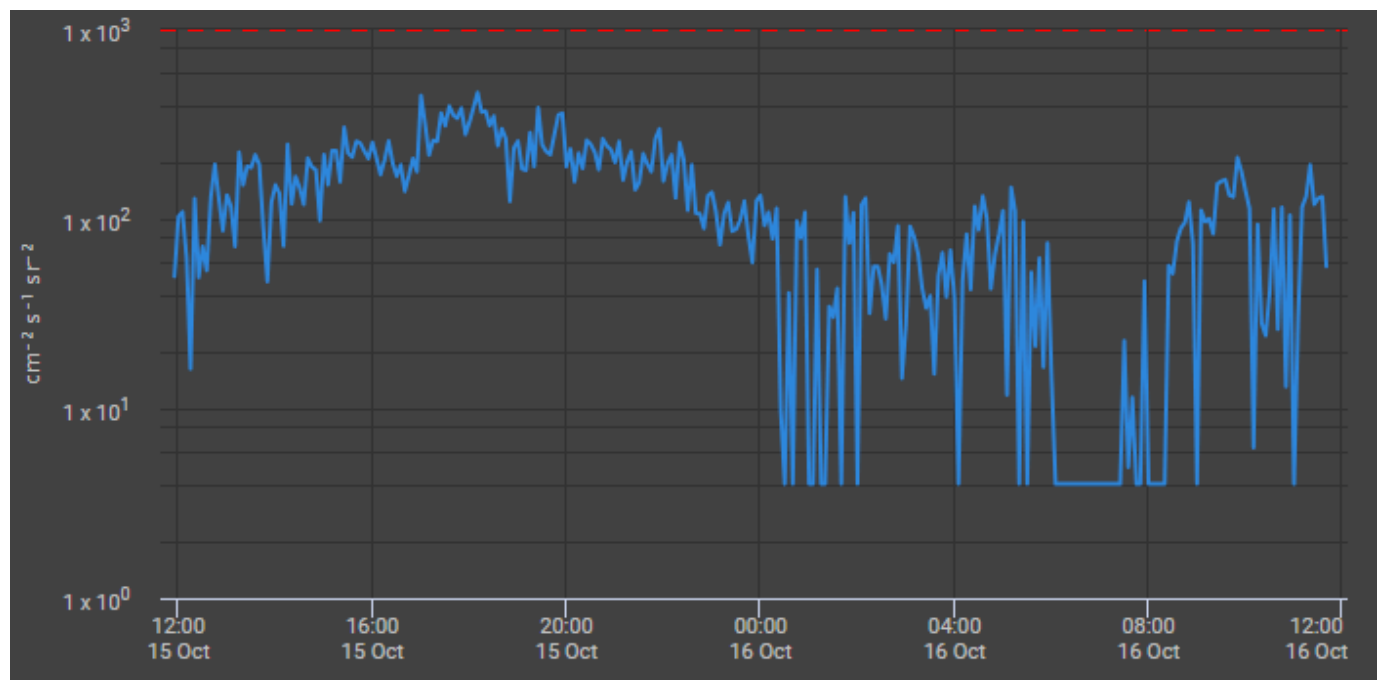


Figure 6: MOSWOC REFM.